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INFECTIOUS
ABORTION
OF
CATTLE



ABORTION DISEASE of cattle is widely distributed and is of great economic importance. It is caused by a germ known as the *Bacillus abortus* (Bang). The disease is commonly introduced into healthy herds by the purchase of affected cows and pregnant heifers.

The act of abortion is its best-known symptom. Other results are weak though living calves, sterility, retained afterbirths, and low milk production.

The germs may be present in the uterus, udder, the generative organs of bulls, certain lymph glands and joints, and in the intestines and other organs of newly born calves.

The germs are eliminated by diseased animals in the fetus, afterbirth, and uterine discharges for limited periods, and in the milk for prolonged periods.

The malady is commonly acquired through the mouth by consuming feed and drink contaminated with the germs, by licking affected animals to which the germs adhere, contaminated mangers or other objects. Proof is lacking that bulls transmit the disease through the act of service.

There is little cause for believing that abortion losses can be prevented or reduced by the administration of drugs or medicinal compounds.

How to deal with an infected herd depends on how extensively the disease has spread, whether the animals are valuable from a breeding or productive standpoint, whether facilities exist for having abortion tests made, and whether provision can be made for dividing and maintaining the herd as separate units among which there is little or no communication.

This bulletin is a revision of and supersedes Farmers' Bulletin 790, Contagious Abortion of Cattle.

INFECTIOUS ABORTION OF CATTLE

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ABORTION WIDELY PREVALENT

PROBABLY NO DISEASE of cattle is the cause of so much discouragement to stock owners in general as the one known as infectious or contagious abortion. It is a disease that is widely distributed throughout the world. How long it has been present in the United States is not definitely known, but probably it was here many years before its economic importance was recognized.

It is no longer confined to dairy cattle, among which the principal losses were formerly found, but has gained considerable headway among beef herds as well.

NATURE OF THE DISEASE

Infectious abortion has been puzzling to stock owners, and also has been the subject of much controversy among investigators. There has been a tendency to regard the act of abortion, its most readily observed symptom or manifestation, as the disease itself. Viewed in this manner it has been natural to suppose that the malady may commonly be acquired just before the act of abortion and that recovery has taken place when the generative organs show evidence of having assumed their normal condition. Experimental studies have plainly shown that this conception of the disease is erroneous and have at the same time revealed something of its true nature.

It has been determined that the act of abortion is merely one symptom or manifestation of the disease, a rather inconstant one in fact, and that the act when occurring is commonly induced by a diseased condition of the membranes through which oxygen and nourishment pass from the dam to the fetus. The diseased condition is brought about by the action of germs which may have invaded the uterus of the dam weeks or even months previously. If the gestation period is well advanced before the membranes become severely affected the calf may be weak but living when expelled. When the infection becomes severe during the earlier months of gestation, the fetus is usually dead on expulsion. (Fig. 1.) Whether the dam expels a dead fetus or a calf with sufficient vigor to survive is determined to a great degree by her ability to resist the action of these germs.

Although the act of abortion is the most readily observed symptom of the disease, it has been noted also that in affected herds (1) sterility or barrenness is commonly more or less troublesome; (2) animals give birth to calves which, although living, may be too weak to resist some of the more common ailments; (3) cows show a tendency to retain their afterbirths, and (4) a reduced milk production is occasioned by the failure of animals to complete their normal gestation periods. Losses due to these conditions may equal or even exceed these represented by the number of calves that are born dead.

The term infectious abortion has sometimes been used in a more or less general manner and applied to any and all cases of abortion

that were associated with bacterial infection. This practice has resulted in confusion, and has prompted the restriction of the term to the communicable and widely prevalent disease induced by the *Bacillus abortus*. In this publication, therefore, the term infectious abortion, or abortion disease, has reference only to the malady which has been definitely shown to be both widespread and readily transmissible and is caused by the *Bacillus abortus* (Bang).

CAUSATIVE AGENT

The transmissibility of the disease was recognized by European investigators in 1876 and 1878, but they were unsuccessful in ascertaining the nature of the infection that was responsible for its spread.

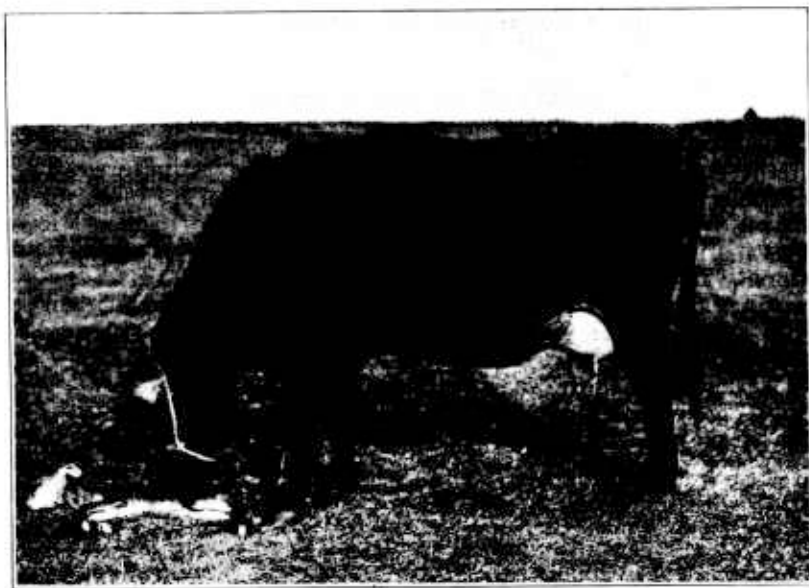


FIG. 1.—A cow with her dead fetus. This abortion occurred during the seventh month of pregnancy. Cattle of all breeds and degrees of breeding may be affected

It continued to remain much of a mystery, so far as its causative factor was concerned, until Professor Bang, a Danish investigator, announced, in 1897, his success in cultivating from the carcasses of aborted calves a certain germ, which if introduced into the blood stream of healthy pregnant cows caused them to abort. This micro-organism he called *Bacillus abortus*. In honor of the discoverer it has since been referred to as the *Bacillus* or *Bacterium abortus* (Bang). English investigators a few years later confirmed the work of Bang. During 1900 it was definitely shown that the same type of infection could be isolated from aborted calves in the United States. The discovery of the abortion bacillus marks an important event in the history of the disease, and much credit is due its discoverer, since the cultivation of the germ necessitated the application of methods that were both unique and original.

Before the discovery of *Bacillus abortus* numerous theories existed as to the cause of abortions. Mechanical injuries, the consumption

of moldy or smutty feed, and exposure to odors emanating from aborted calves were thought to cause it. Although such theories have been largely abandoned investigators have determined nevertheless, that it is not always possible to demonstrate the presence of the *B. abortus* in all calves that are expelled dead or immature, or in their membranes. Numerous types of germs other than *B. abortus* have been cultivated artificially from aborted calves. Their significance as causative agents is, however, not completely understood, for while they have been repeatedly found in the organs and parts of aborted calves, their injection into healthy, pregnant cows seems rarely to cause abortion.

During recent years investigators of diseases have been engaged to a considerable extent in studying the effects of certain feeds or the withholding of certain feeds on the health of animals and the proper functioning of the different organs. The results of these studies have suggested that improper feeding may have some connection with breeding irregularities.

LOCATION OF BACILLUS ABORTUS IN INFECTED ANIMALS

The act of abortion furnishes little information as to when the disease was contracted or when it will be overcome by an animal. The tendency on the part of the germs to multiply in the bodies of animals for long periods justifies its recognition as a chronic malady. Information as to the location of the causative bacilli and the ways by which they are eliminated is of importance to those concerned in the eradication of the disease. With an understanding of these factors one is in a favorable position to guard against the transference of the infection from diseased to healthy stock.

The fetus, fetal membranes (afterbirth), and discharges from the generative organs at time of aborting and for a variable period afterwards are usually saturated with the germs. Discharges slightly before the act may also contain the infection. These are circumstances which contribute greatly toward rendering the control of the disease most difficult. Probably in no other infectious disease of cattle does the affected animal eliminate so excessive a quantity of infective material during a brief period as does the aborting cow.

The aborting animal, moreover, is not alone responsible for scattering the infection. Infected cows, although they produce seemingly normal calves, may be as menacing to healthy stock as if they had aborted because their afterbirths and uterine discharges may contain myriads of the abortion germs, a feature that until recent years escaped observation.

In only rare instances have the germs been found in the genital tracts of cows for any great length of time after the dead or living calf has been expelled. Experimental tests indicate that they are seldom present in the discharges longer than three or four weeks although in rare instances they have been found nearly two months after the expulsion of the calf or fetus.

The udders of many infected cows, whether they abort or not, contain and eliminate the germs for a widely variable period. Investigators have never been able to understand or account for the wide variation that exists in the length of time that udder infection persists in different animals. Experimental work has indicated that

the abortion bacilli may be present in the milk of some infected cows during almost, if not quite, their entire lives after the malady is contracted. Other animals, however, recover from udder infection during the course of a few months or even weeks.

Since it has not been possible to prove that the bacilli commonly live in cows for any great length of time except in their udders and adjacent lymph glands, their disappearance from these organs probably signifies in most cases that they are no longer present in the animals. Furthermore, experiments have indicated that those animals which have ceased to eliminate the germs from their udders possess a marked degree of resistance to the affection. On the other hand, as long as udder infection persists, it appears to act as a source of infection for the pregnant uterus, although invasion of the latter organ may not uniformly occur. Unlike numerous varieties of germs, the abortion bacilli, when present, do not appear to produce harmful results in the udder. The multiplication of the germs in this organ seems to be merely a provision of nature for the perpetuation of the infection during those intervals when conditions are unfavorable for growth of the germs in the uterus.

In some instances the infection establishes itself in and causes permanent injury to the generative organs of bulls, and it has also been proved that the seminal fluid of infected bulls may contain abortion bacilli. (Fig. 2.) The discovery of these facts is of considerable practical importance, not only because they reveal the limitations of sheath douchings as a means of rendering the bulls' generative organs free from the causative germs, but because they also explain why bulls should be so handled as to prevent their discharges from contaminating premises accessible to abortion-free stock.

Newborn calves from abortion-infected dams may harbor the infection in their intestines and other organs for a brief period and therefore constitute possible sources of infection to abortion-free stock for limited periods. Experimental tests, however, have failed to indicate that the abortion bacilli are eliminated by such calves over an extended period; consequently, minor importance is attached to the spread of the disease by them.

Other locations where the abortion germs have been detected in animals are certain lymph glands and joints, but their presence in these locations has been demonstrated only when they could be isolated from other sources in the animal.

HOW AND WHEN THE DISEASE IS ACQUIRED

How animals commonly acquire the disease is a question that has engaged the attention of investigators since the discovery of the abortion bacillus.

For a time it was supposed that the germs gained lodgment on the external genitals of cows and were conveyed through the vagina to the uterus, where they set up inflammation. It was believed that the transference of the abortion germs from the affected to the healthy animal resulted from contact with contaminated gutters or from direct contact between the healthy and the diseased animals. Spraying the tails and external genitals of cows with antiseptic solutions was considered advantageous as a control measure.

It has also been generally believed that cows and heifers commonly contract the disease at time of service. Bulls though not infected themselves have been considered capable of transferring the germs from affected to healthy cows by the soiling of their generative organs. This theory appeared to be so logical that its accuracy for many years remained unchallenged, but results of more recent experiments have failed to substantiate it.

Calves seem to be wholly immune against abortion bacilli, though at one time it was supposed that they might carry them in their bodies from birth to maturity. Careful studies have supplied no evidence to support the supposition. At what age young cattle lose their immunity has not been determined.

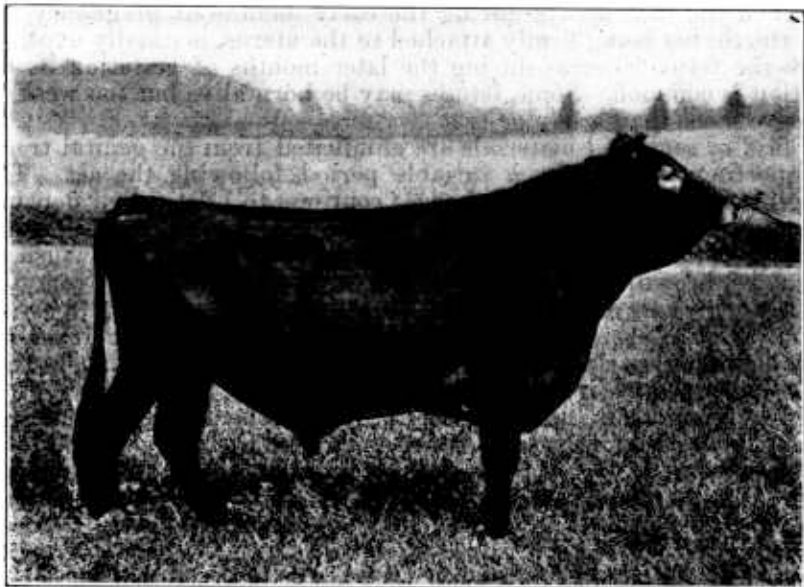


FIG. 2.—A bull which proved to be infected with abortion germs, thereby destroying his value as a sire. The disease is rarely evident from the animal's physical appearance and is no respecter of breeds

The readiness with which susceptible, pregnant cows and pregnant heifers may be infected through the digestive tract by feeding them discharges from cows which have recently aborted has led most investigators to conclude that the malady is commonly acquired by way of the mouth. The disease has been produced experimentally not only in pregnant cows and heifers through this channel, but unbred cows have likewise been made carriers of the germs in their udders and milk. Not only has it been possible to infect cows readily in this manner but it has been accomplished when the quantities of material fed, containing the germs, have been surprisingly small. Experimental results have been so uniform when this method of exposure has been practiced as to leave little room for doubt as to the accuracy of their interpretation.

SYMPTOMS

The symptoms or signs which denote the presence of infectious abortion are rather inconstant and indefinite. The act of abortion is

probably the one which is the most widely known and most readily observed, but it may easily be misinterpreted, since all cows which abort are not affected with the disease. Its prompt recognition in diseased herds is, moreover, rendered difficult because of the fact that many animals which acquire the disease never abort.

When the act of abortion occurs it may be preceded by changes in the dam that are commonly observed in cows which are approaching normal parturition, such as enlargement of the udder, slight swelling of the external genitals, uneasiness, and straining. Discharges from the genital tract preceding the act may occasionally be observed. The fetus may be expelled during any stage of its development. If the fetus is small, the act of abortion may occur unobserved.

When the dam aborts during the early months of pregnancy the afterbirth, not being firmly attached to the uterus, is usually expelled with the fetus, whereas during the later months of gestation its retention is common. Some fetuses may be born alive but too weak to survive more than a day or two.

Fluid or semifluid materials are eliminated from the genital tracts of aborting animals for a variable period following the act. The length of time that such discharges continue to be expelled depends on both the severity of the disease process in the uterus and the manner of treatment employed. The discharges are usually brownish or yellowish brown, but may not differ greatly in appearance from discharges in cases of retained afterbirth not caused by the abortion germ. The afterbirth, when expelled or removed and examined before becoming markedly putrefactive, frequently shows changes that aid the trained observer in recognizing abortion disease.

Areas of the membrane that are normally thin and translucent may present a leathery appearance or be studded with small elevations, and the borders of the cotyledons (tumorlike enlargements, where union between dam and fetus is established), may consist of a cheese-like substance. The irregular surfaces of some of the cotyledons may likewise be occupied by this cheeselike material. The absence of these changes, however, does not necessarily indicate that the abortion germ has not been active.

It has been observed that barrenness is usually a troublesome factor in herds into which the disease has gained entrance. Although cows which have aborted may conceive at the first service, it is often necessary to breed an aborter repeatedly before conception takes place. Heifers as well as the aborting cows in such herds may show irregularities in breeding.

Because sterility (barrenness) frequently causes more or less trouble to the owners of abortion-free as well as the owners of abortion-infected herds, its presence does not constitute definite evidence that the abortion germ is involved. The retention of the afterbirth likewise does not afford definite information as to the presence or absence of the disease, since that was a frequent calving complication in this country before infectious abortion became widely prevalent.

Although none of the symptoms mentioned furnish definite knowledge as to the presence or absence of the malady, they may well be regarded with suspicion and as justifying prompt action in dealing with the situation. This is particularly true of the act of abortion. Until a definite diagnosis can be reached it is wise to infer that an

aborting animal is affected with the disease and to proceed in accordance with that inference.

DIAGNOSIS

During recent years the blood or serum tests, so called because of their application to the blood serum of the suspected animal, have been extensively used for diagnostic purposes. Those which have given the best results are known as the agglutination and complement-fixation tests. In conducting these tests varying quantities of blood serum from the suspected animal are combined in test tubes with either the abortion germs or products of the germs. When the blood serum has been obtained from animals that have acquired the disease the changes that take place in the tubes differ from those occurring when the serum was taken from abortion-free subjects. The tests fail to distinguish accurately, however, between animals that are carrying the abortion germs in their bodies and those that formerly were carriers but no longer harbor the infection. The tests are nevertheless of marked value to the stock owner who finds it necessary to introduce new animals into his abortion-free herd. They have also been used to some extent in eradicating the disease from infected herds.

TREATMENT

Before the true nature of infectious abortion was well understood, it was natural to suspect that medicinal substances could be used to advantage in preventing animals from aborting. This view was so widely entertained and advanced for years that it has been difficult to become thoroughly convinced of its falsity. Testimonials relating to alleged medicinal cures or preventives have sometimes been so extravagant as to be alluring to the discouraged stock owner.

Medicinal substances in the treatment of this disease have gained their popularity almost, if not entirely, because they were used and their value was judged at a time when the disease had run its natural course. It may be said that the administration of no drug or medicinal compound has proved to be effective in the cure or prevention of this disease.

Treatment in many cases should be given the aborting animal, particularly when there is retention of the afterbirth. Vaginal and uterine douches with nonirritant, antiseptic fluids or solutions of common salt, when properly made, seem to hasten recovery of the generative organs and frequently prevent subsequent barrenness. Treatment of this character, however, should be undertaken with the idea of washing the germs out of the generative organs and to relieve inflammation, and not with the expectation that abortion bacilli will thereby be completely destroyed.

PREVENTION

The information that is at present available bearing on the disease should be of particular interest and practical value to owners of herds into which the disease has not gained entry. It should not be a very difficult matter to maintain such a herd once it is built up or assembled. Dairy owners who have recognized the importance of excluding the malady have demonstrated that it may be accomplished.

There are reasons for believing that the disease is most commonly introduced into clean herds by the purchase of cows or pregnant heifers that carry the germs in their bodies. A cow with a calf by her side may be a spreader of the causative germs or may become a spreader later, since it is well known that infection of the after-birth does not always result in the death of the fetus. Bulls and unbred heifers are less liable to act as agents of dissemination and may therefore be added to noninfected herds with more safety.

The food supply offers another possible agent for spreading the disease. Roughage and grain, if produced on farms where infectious abortion exists, may become soiled with the discharges of infected animals and, when consumed, may transmit the disease. The infection is probably introduced in some instances through a pasture that receives drainage from a farm where the malady is present. There is also the possibility that animals pastured near railroads may be exposed by the scattering of contaminated bedding from stock cars. Unpasteurized milk from creameries or other sources may readily carry the germs to the farms where the milk is used.

It is highly probable, however, that the infected cow or the infected pregnant heifer is mainly responsible for the development of new centers of infection and that their exclusion from a noninfected herd would usually mean freedom from the disease.

The serum tests are of considerable value in enabling purchasers of animals to distinguish between the infected and the noninfected, but they have their limitations in this respect. It has been determined that pregnant heifers may remain negative to the tests for as long a period as five months after an exposure to the germs of sufficient intensity to cause abortion later, and that in some cases reactions may develop only a brief period before the act occurs. It is, therefore, evident that difficulties confront the stock owner in keeping his herd free from the affection while adding to it stock from questionable sources.

HOW TO DEAL WITH INFECTED HERDS

How to eliminate the disease from herds after it has gained entry is a more complicated and arduous problem than preventing its introduction.

In deciding on a method to be used in individual herds it seems advantageous to take numerous factors into consideration, such as what proportion of the herd have already acquired the disease; whether the animals are valuable from a breeding or productive standpoint; whether facilities exist for having abortion tests made; and whether provision can be made for dividing and maintaining the herd as two or three separate units between which there is little or no communication.

The total elimination of the affected animals should be contemplated first of all. Owners sometimes seem to conclude that the disposal of aborters accomplishes this object. Except in rare instances, that is not the case. A reasonably accurate idea of the extent of the disease in an infected herd can be arrived at only by an abortion test of the entire herd.

When such a test indicates that comparatively few animals have acquired the disease it may be economical in the end to sell them

for immediate slaughter and thoroughly disinfect the premises. It should not be inferred, however, that the original test detects every animal that is harboring the germs. Several weeks or even months may elapse before an animal gives a reaction to the test after the germs have gained lodgment within the animal. Therefore, two or three tests at intervals of six weeks or two months would be required to determine whether all the diseased animals had been removed. Dealing with the disease in this manner should appeal strongly to owners of purebred animals who derive their profits mainly from the sale of stock. The conscientious individual should derive much satisfaction from the knowledge that herds into which his stock is introduced will not thereby be imperiled.

When the abortion tests reveal that half or more of the animals of a herd have acquired the disease, the disposal of reactors for slaughter is seldom economical. Under these conditions the method is rarely appropriate except in the case of beef herds in which profits are dependent on the calves produced or in herds where the reacting animals can be replaced without considerable loss.

A less drastic method of dealing with infected herds, provided the facilities exist, consists in handling the reactors as a separate unit, with different stables, utensils, pastures, and attendants. This plan can frequently be used to advantage in herds where two or more stables and exercising lots or pastures are available but it is less practicable in small herds where limited stabling facilities prevent the complete separation of the reactors from the nonreactors. The frequent application of the tests to the noninfected portion of the herd is necessary that carriers of the infection may be promptly detected and removed.

Other methods that have been used more extensively and with a variable degree of success include sanitary management and artificial immunization. These methods have frequently been used in combination.

SANITARY MANAGEMENT

Sanitary management consists in handling the animals in a herd so as to reduce materially the transference of the germs from the diseased to the healthy. It is not very popular, for the reason that it is a more or less continuous undertaking requiring both vigilance and perseverance. While it fails to insure freedom from abortion losses it frequently accomplishes highly beneficial results.

As mentioned, some of the known germ-bearing substances expelled by cows and heifers are the fetus, afterbirth, and uterine fluids for a limited period following abortions, and the milk for prolonged periods. The germs are also expelled in the seminal fluid of infected bulls and in the feces of the calves of infected cows. It is also well known that cows which appear to calve normally may expel afterbirths and uterine fluids which are saturated with the causative germs. A knowledge of these facts, associated with the information that animals may readily acquire the disease through the digestive tract, suggests the following recommendations for preventing the spread of the disease in infected herds by sanitary management.

Make frequent observations of all animals for symptoms of aborting, such as swelling of the external genitals or udder enlargement,

and on the discovery of such an animal place her immediately in a separate stall well away from other stock. If an abortion occurs unexpectedly, isolate the animal in the same manner as soon as the discovery is made. Bury or completely destroy the fetus and after-birth if the latter has been expelled. Clean and apply disinfectant solutions to areas that may have become contaminated by the abortion products.

Place all pregnant animals in individual stalls a week or 10 days before calving and confine them to their calving quarters for a month following calving and as long afterwards as uterine discharges can be detected.

Clean and disinfect the maternity stalls before placing pregnant animals in them; otherwise they may constitute sources of infection. Avoid carrying germ-laden material from maternity stalls to other parts of premises on hands or clothing. The footwear of the attendant should be well scrubbed with a disinfectant solution after he has been in an infected stall.

Refrain from breeding fresh cows for at least two months after calving or aborting. Bulls serving cows after such an interval should rarely if ever thereby acquire the disease or contaminate their generative organs with the causative germs.

Keep aborting animals isolated for a period of from six weeks to two months. Cows with uterine discharges should always be kept away from the rest of the herd, whether they have aborted or not, until they have recovered.

Dispose of the bedding used by infected or suspected animals in such manner as to render it inaccessible to stock which is free from the disease.

Use care in the management of the bull. Do not permit him to run with the herd or to serve cows on lots that are occupied by abortion-free stock. While transference of the disease may seldom occur by the act of service the discovery that infected bulls may eliminate the causative germs in their semen makes it plain that such bulls may be capable of contaminating their environment, which would then become a menace to abortion-free stock. Bulls giving marked reactions to the abortion tests should not be used for service. Even though danger of spreading the disease thereby may be slight, such reactions strongly suggest infection of their generative organs. The reproductive power of such animals may be greatly impaired if not destroyed.

The best results accruing from sanitary management have been derived in those herds to which no cows or heifers other than those produced in the herd were added. There are reasons for suspecting that the introduction even of animals that have never come in contact with the germs may be a detriment to the accomplishment of the desired end. Such animals may acquire the disease more readily than those raised within the herd, and there is also a strong probability, when highly susceptible animals become infected and abort, that their products of abortion are more heavily infected with the causative germs than the same substances from animals which may have previously developed some degree of resistance to the malady. These factors, in all probability, are responsible for some of the discouraging results obtained by those who have endeavored to control the

affection in their herds while adding to them by purchase rather than by the development of their own stock.

HANDLING YOUNG STOCK IN INFECTED HERDS

The care of the growing stock in infected herds deserves mention. The germs are not known to localize in the bodies of young calves. When they harbor the infection in their bodies at birth the infection is usually overcome in a reasonably brief period. Heifers, as they approach breeding age when running with infected cows, occasionally acquire the malady, and following conception the danger is increased to a marked degree. Better results consequently may be expected when heifers are separated from the infected stock during their first pregnancy.

IMMUNITY

There are certain infectious diseases to which domestic animals become resistant after sustaining one attack. This acquired resistance is commonly referred to as immunity. In some diseases investigators have learned to impart such or similar resistance in an artificial manner so that the animal acquires the resistance without suffering an attack of the disease. Much experimental work has been directed toward devising a successful method of producing immunity against infectious abortion.

Substances which have been used include vaccines, bacterins, and serums. Abortion vaccine contains living abortion germs; abortion bacterin, the germs which have been killed; and abortion serum, the fluid portion of the blood of animals that give a marked reaction to the abortion tests. The customary practice is to inject one of these substances beneath the skin of the animal to be rendered immune.

THE USE OF ABORTION VACCINE

Numerous investigators who have studied the value of these substances arrived at the conclusion that the benefit derived from the use of bacterin and serum is not sufficient to compensate for the labor and expense involved in their administration. Abortion vaccine, on the other hand, has yielded results of an encouraging nature. Such a product may be of considerable practical value in combating the malady.

Abortion vaccine contains the living causative germs; therefore it should never be used except in herds where the disease is definitely known to exist; otherwise new centers of infection may be established. Pregnant animals should never receive this vaccine as prepared at the present time, since it would be liable to cause the disease rather than act as a preventive. It seems advantageous to refrain from breeding treated animals for at least two months after treatment.

The manner of treatment has been criticized to some extent, because it has been supposed to render animals carriers of the infection for long periods. There were reasons for inferring that carriers would commonly be produced thereby, in view of the fact that many animals which acquire the disease under natural conditions frequently remain carriers for years. This view, if true, would certainly be cause for questioning its practical value. Exper-

imental results, however, have indicated that in most cases animals are but temporarily infected by the subcutaneous injection of the vaccine when the product is made from strains of the causative germ that have been under artificial cultivation for long periods. Unbred heifers appear to resist permanent infection more successfully than unbred cows.

One should guard against entertaining the impression that vaccination in a large measure solves the problem of abortion control. Little or no evidence has been obtained indicating that animals which have already acquired the disease and are carriers of the causative germs are benefited thereby. There are, moreover, reasons for believing that the animal which has sustained an attack of the disease but is no longer a carrier is more resistant to reinfection than she could be rendered by vaccination. Thus its usefulness may be limited to animals which up to the time of treatment have escaped the disease or that give negative results to the abortion tests. Vaccination seems to be a more appropriate treatment for unbred heifers than for unbred cows, not only because of their tendency to resist permanent infection more successfully but also because unbred heifers, even though raised in an abortion environment, rarely give evidence of having contracted the affection.

The immunity that may be imparted by vaccination has not given evidence of being sufficient always to afford complete protection against the disease. Therefore sanitary management should be practiced when efforts at immunization are attempted.

RETAINED AFTERBIRTH

Retention of the afterbirth is a common condition in herds where abortion disease prevails. Owners are frequently at a loss to know what action to take, when the condition occurs. Since the afterbirth in the case of healthy animals often is not expelled until after a few hours, owners are justified in viewing its retention with little alarm until 24 hours after the act of abortion or parturition, provided the animal appears to be normal otherwise. When the afterbirth is retained longer than 24 hours it is liable to signify that inflammation of the uterus is present and responsible for its adherence. When the afterbirth has been retained for 2 or 3 days its putrefaction usually becomes marked. In this putrefactive process within the uterus poisonous substances may be generated and absorbed by the animal, causing fever, loss of appetite, and other evidences of severe trouble. Invasion of the blood stream by the bacteria may terminate fatally.

The afterbirth is frequently removed before putrefaction is excessive by reaching into the uterus with the hand and separating as carefully as possible the attached areas and flushing the organ out afterwards with mild antiseptic solutions or warm salt water. A 0.5 per cent Lugol's solution¹ is often used for this purpose. Boiled water which has been permitted to cool to body temperature and to every gallon of which 1 heaping tablespoonful of table salt has been added makes a satisfactory irrigating fluid.² The flushing may be

¹ Lugol's solution of iodine is compounded as follows: Iodine, 5 parts; potassium iodide, 10 parts; and boiled water to make 100 parts. One part of this compound to 200 parts of boiled water makes a solution suitable for uterine irrigation. Lugol's solution may be purchased from any druggist.

² A 1 per cent solution of common salt in boiled water at body temperature makes a suitable irrigating fluid. A heaping tablespoonful of dry salt weighs approximately 1 ounce, and this quantity in 1 gallon gives the proper strength.

done by the use of a soft-rubber tube with a diameter of about half an inch, to which a funnel is attached. The fluid should not be allowed to remain long in the uterus, but should be siphoned out by lowering the external end of the tube when filled with the fluid.

Removal of the afterbirth by hand can seldom be accomplished without causing some injury to the uterine walls, a factor that renders the operation of uncertain value. A putrefactive afterbirth in contact with injured uterine walls may readily be more harmful and more likely to produce fatal effects in animals than its contact with an uninjured uterine surface.

A less drastic method of dealing with the condition is consequently often advisable. This method permits the afterbirth to remain attached to the uterine walls and by introducing into the uterus mild antiseptic substances the rapid multiplication of germs is prevented until the membranes come away of themselves. Separating the pendent portion of the afterbirth from the retained part about 6 or 8 inches exterior to the vulva is a means of reducing the contamination of surroundings. A dram (level teaspoonful) of iodoform combined with a quart of mineral or olive oil and introduced into the uterus through a rubber tube is recommended. The milk of animals so treated may have an iodoform odor for several days and should therefore be discarded for food purposes. Such irrigating fluids as those mentioned for washing out the uterus after removal of the afterbirth by hand may be used, but seem to be less efficient than iodoform and oil. It is seldom advisable to introduce irrigating fluids more often than once a day or once in two days. Although animals have been known to retain the afterbirth for as long as 10 days following a single administration of iodoform and oil, as described, they appeared to experience little discomfort or harm.

Retention of the afterbirth is a more serious condition than often realized, since it may be followed by or induce barrenness. It is because of this fact that the assistance and experience of a qualified veterinarian are highly desirable.

STERILITY (BARRENNESS)

Sterility commonly gives the owners of abortion-infected herds no little concern. Although the abortion germ seems unable to thrive in the uterus of a cow for any great length of time, it indirectly seems responsible for a high percentage of barrenness for the reason that it induces a condition in the uterus that invites numerous other types of germs more permanent and destructive. Sterility troubles may logically be expected when cases of retained afterbirths are treated carelessly or with unconcern.

Sterility may result from bacterial infection of the vagina, the uterus, or the tubes that convey the ova from the ovaries to the uterus. There are also diseased conditions of the ovaries that may cause interference with conception or regular heat periods. Sterility may furthermore be the result of incomplete development of certain of the generative organs. Determination of the cause is not always possible.

Owners of herds, as mentioned, can prevent the trouble to some extent by limiting the spread of abortion disease as well as by making sure that all cases of retained afterbirth receive proper attention.

Every case of sterility of long standing is a study in itself, and should be intrusted to the care of a veterinarian when the value of an animal justifies such a procedure. Appropriate treatment in individual cases can be determined only after a careful examination of the generative organs. Although it is not always possible to eliminate diseased conditions when they have been found, professional advice as to the outlook for recovery is frequently of value to the owner because it enables him to dispose of hopelessly sterile animals promptly.

Failure of cows and heifers to conceive is sometimes the result of the use of a bull incapable of producing conception. Owners are cautioned against considering cows permanently sterile until they have been bred several times to a bull of known fertility, for it is by no means unusual in abortion-infected herds to have cows conceive on the fourth or fifth service, even in the absence of treatment.

ABORTION IN OTHER ANIMALS

Abortion troubles, although of more economic importance in cattle than in other animals, frequently give the owners of horses, sheep, goats, and swine considerable concern. The *Bacillus abortus* (Bang) has never been reported in the uteri of sheep which have aborted, except after experimental infection. Experimental studies of various investigators have indicated that, in the case of sheep, a germ classified as a spirillum or vibrio may be the more common causative factor and that the affection may be readily transmitted from one animal to another.

A germ known as *B. abortivo-equinus* is frequently found in the fetuses of aborting mares and has come to be generally regarded as the principal offender in this species of animal. This germ, however, bears little resemblance to *B. abortus* (Bang), the causative agent in cattle.

In the case of swine, abortion losses are caused by a germ with very similar characteristics to the germ found in aborting cows. The resemblance is so close that they have commonly been considered identical. Investigational work has indicated that the germ in swine may have somewhat more virulence than that found in affected cattle.

Although knowledge is less definite as to how domestic animals other than the cow acquire the germs causing them to abort, it is highly probable that the manner in which the germs gain entrance is through the mouth, as in cattle. In view of the fact that the fetuses, afterbirths, and uterine fluids of affected animals are liable to be infected with the germs, it is reasonable to conclude that the measures recommended under sanitary management for preventing the spread of the malady in cattle likewise apply in the case of horses, swine, and sheep.

Various investigators during recent years have derived considerable encouragement from bacterin treatment as a means of reducing abortion losses in mares when induced by *B. abortus equinus*. But present knowledge is very indefinite as to whether benefit may be derived from immunization efforts in connection with sheep and swine.